CHAPTER V.2. SYMPTOM GROUPS

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CHAPTER V.2. SYMPTOM GROUPS

V.2.A. Background

Many environmental irritants and allergens, whether chemical or biological, can cause systemic toxicity and irritation of mucous membranes, leading to pain and related symptoms. The Indoor Environments Division has been evaluating impacts of various indoor air pollutants. This analysis examines the direct medical costs of addressing symptom groups, such as eye irritation, throat irritation and pain, coughing, headaches, and other non-life-threatening medical conditions, to address the division's specific requirements.

This chapter contains a discussion of the methods used to estimate the annual direct medical costs of treating specific symptoms in the absence of serious disease. It does not include information on cost elements such as indirect medical costs, pain and suffering, lost time, etc.[1] The reader is referred to Chapter I.1 for a discussion of the general methods and cost elements relevant to all benefits estimates, and for a discussion of the limitations of estimating medical costs.

The costs presented in this chapter were current in the year the chapter was written. They can be updated using inflation factors accessible by clicking on the sidebar at left.

Link to Chapters I.1
Link to inflation factors

V.2.A.1. Symptoms Evaluated

The symptoms evaluated in this chapter are:

- dry, itching or irritated eyes;
- headaches;
- sore or dry throat;
- unusual tiredness;
- fatigue or drowsiness;
- stuffy or runny nose or sinus congestion; and
- dry or itchy skin.

The costs of diagnosis and treatment are moderate because these symptoms are hypothesized in this analysis to result from irritation and allergies. They

[11] Some of these cost elements, especially pain and suffering, may comprise a very large portion of the benefits of avoiding symptoms. Because these cost elements are difficult to assess, it was not feasible to estimate them for this chapter.

may also indicate, but are not considered in this chapter to be symptoms of, more serious diseases. In addition to treating the symptoms listed above, this analysis includes the cost of evaluating allergic responses that may also trigger these symptoms. The allergic diagnosis and treatment costs may be applicable to many of the symptom groups for some patients.

This chapter contains a discussion of the annual incremental direct medical costs incurred by individuals experiencing symptoms assumed to be related to poor indoor air quality. The symptoms could also result from other causes but may incur different costs, depending on the circumstances (indicating differences in underlying pathology). The methods used to estimate costs are relatively simple and direct because the symptoms are evaluated under the specified condition that they occur in the absence of other complicating factors and are not a result of serious diseases. Consequently, this chapter does not follow the usual format of chapters in the Handbook. Many details on medical definition, causality, susceptibility, prognosis, etc., are omitted because they are not appropriate to this chapter.

Patients may experience the symptoms for weeks, months, or years. The costs, presented as annual costs, can be pro-rated for the duration of time appropriate to the analysis being performed. An exception is made for the costs of allergy treatment, included here as supplementary information. This information includes those costs associated with the usual five-year course of allergy treatment. This analysis also provides sufficient information for the reader to calculate allergy treatment costs for periods other than five years.

The costs provided in this chapter may be used in a variety of applications; but the data have limitations. Regulation of air pollutants may result in a reduced number of individuals with air-related symptoms. Programs to reduce indoor air pollutants, such as environmental tobacco smoke (ETS), are also crucial in reducing adverse health effects. The benefits of such activities can be estimated, in part, by evaluating the direct medical costs avoided. As noted above, a full measure of cost would also include direct non-medical costs and indirect costs. The direct medical costs presented in this chapter may be useful in providing a lower-bound measure of willingness-to-pay.

V.2.A.2 Nature of Symptoms

As discussed in Chapter V.1 , evaluation of symptoms can be complex because they are not diseases per se. Symptoms are evaluated with other clinical information by a medical professional to determine an underlying cause that usually results in the diagnosis of a specific illness.[2] For

[2]Illness and disease are used in this handbook to designate any adverse health condition.

example, a sore throat may be associated with a streptococcal infection, a cold, or a variety of other causes. Unusual tiredness may be linked to chronic fatigue syndrome (CFS), anemia, pregnancy, stress, and multiple other causes. A runny nose may be due to a cold, allergies, or some other cause. It is not always possible to link the symptoms and clinical data to a specific disease, and may be very difficult especially in the case of indoor pollutant-induced symptoms. Many physicians are not familiar with the potential effects of such pollutants and consequently may not consider them as a source of the patient's symptoms.

The difficulties in estimating costs for symptoms are twofold:

1. symptoms related to irritation and allergic responses vary widely in their severity, from a barely noticeable annoyance to a life-threatening systematic response; and

2. the medical literature and system of payments for care is based on diagnosis of a disease or the cause of the medical visit.

Cost data are derived from a description of the medical services most likely to be provided to a patient seen for a specific symptom or array of symptoms. Determining which services are likely to be provided then yields reasonable cost estimates. In the specific case of indoor air pollution, symptoms can be associated with a variety of indoor air quality problems. Consequently, most cases involve no specific, readily identifiable disease. *It is an open question as to whether physicians could discern from the patient's medical history and a physical examination that the symptoms are the result of indoor air quality problems.* If they do not diagnose the actual cause of the symptoms, and the symptoms persist, the physician may do a wide variety of tests to try to determine the cause. These tests can be very expensive.

Allergies pose a particular problem, and illustrate the dilemma posed by symptom cost analysis. Allergies are a common cause of most of the symptoms listed above. Allergy screening and follow-up allergy management are relatively expensive when compared with the cost of treating only the symptoms. In addition, medications to treat allergies may cause other diseases, which in turn require treatment. The medications may also cause activity restrictions and limit school and job performance.

Various components of the immune system mediate many types of allergies. Due to the complexity of diagnosing and treating allergies, patients are commonly referred to an allergist when allergies are suspected by a primary care physician. This chapter provides data on one type of allergy testing and treatment, IgE-mediated, which is the most common type of allergy and often causes the symptoms listed above. Its applicability will depend on the agents responsible for causing the allergy.

Symptoms do not necessarily indicate relevance; other types of allergic responses may cause the same symptoms as those listed. Determining which allergic responses apply requires a clinical understanding of symptom induction, likely immune system response (e.g., IgE, IgG), and responses to various medical tests. The IgE-mediated allergic response is used as an example in this discussion of allergy testing and treatment costs. Medical diagnosis and treatment of other types of allergic responses may have higher or lower costs than those reported in this chapter.

Numerous other difficulties are associated with evaluating the medical costs of diagnosing and treating symptoms. Evaluating some symptom groups can result in extensive testing. Unusual tiredness, fatigue, or drowsiness may result from a large number of diseases and disorders, including (but not limited to) anemia, sleep disorders, apnea, leukemia, and chronic fatigue syndrome. Screening for all these diseases would be very costly and time consuming. Headaches may also be evaluated through sophisticated methods, including magnetic resonance imaging (MRI), computed tomography (CT) scans, spinal taps, evaluations by neurological specialists or ophthalmologists, and many other procedures.

Although extensive testing and referrals to a specialist may be used in some cases, the percentage of patients who will undergo this level of evaluation is unclear for most symptom groups. Data were located on CT scan use for patients with headaches in a study of 58 medical practices. The study found that CT scans were ordered for only 3 percent of patients, mainly for those believed by physicians to have a tumor. Additional neurological signs and symptoms beyond the presence of a headache would indicate this procedure. The percentage of patients with only a headache who would receive a CT scan is unclear, but is likely to be considerably less than 3 percent. This example illustrates the difficulty, even in the presence of studies, in assessing the probability of medical services for symptoms that go beyond a basic examination.

One of the more difficult symptom groups to evaluate is fatigue and drowsiness. These symptoms are similar to those reported for chronic fatigue syndrome, and it was felt that the diagnosis might have some common elements. EPA consulted a project manager of a large study of chronic fatigue syndrome to gain some insight into what tests might likely be conducted on patients who visit a physician due to fatigue. Her observations of numerous physicians' methods indicated that careful history taking and physical examination were of paramount use and the most common diagnostic tools. In addition, physicians usually do a simple blood screen (complete blood count and in some cases thyroid screening) to rule out anemia, hypothyroidism and other obvious and common causes

(systemic infections, etc). Even though chronic fatigue syndrome is a diagnosis of exclusion, extensive diagnostic testing was not done routinely (Carrol Emmons, Abt Associates, 1999).[3]

If patients are screened to rule out most other possible disorders, then medical costs will be high and treatment may be time consuming. There are many options for the evaluation of each group of symptoms listed above, including x-rays, laboratory tests, biopsies, and other costly diagnostic tools. Even the treatment of symptoms that may be considered minor, such as runny nose, may be costly. Treatment of runny nose (rhinitis) is considered costly by some practitioners, and rhinitis and its treatment can complicate other illnesses (Guarderas, 1996).

Due to the potential variability in diagnosis and treatment practices and costs, it is not possible to precisely describe the "likely" approaches taken by clinicians. To clearly define the basis of cost, however, it is necessary to either establish the way in which symptoms will be approached by the "average" physician, or make explicit assumptions regarding medical services. The cost estimation method used in this analysis, as stated above, is based on a best cost-conservative estimate of how the average physician will diagnose and treat the patient.

V.2.B. Methods of Cost Estimation

Medical costs were estimated for this chapter by:

1) describing the anticipated diagnosis and treatment services using national guidelines and the medical literature;

2) assigning costs to those services, based on current (1999) Medicare reimbursement values; and

3) estimating the costs over a period of one year for all symptom groups and over five years for allergy treatment.

V.2.B.1 Sources

The primary sources consulted for this chapter were clinical practice guidelines (AHCPR, 1999; CDC, 1999), medical texts (e.g., Bennett and Plum, 1996), and the Medicare reimbursement Federal Register notices

[3] Published articles from the Abt study will not be available for some time. The study focuses on chronic fatigue syndrome, not air-related fatigue, but the diagnosis of chronic fatigue syndrome has clear implications for this analysis.

regarding costs (numerous; discussed in Chapter IV.2 on asthma). This chapter relies extensively on the National Guidelines Clearinghouse (www.guidelines.gov) developed by clinicians and researchers, which provides clinical practice guidelines. EPA also reviewed numerous journal article abstracts, but used these primarily as supporting information (to confirm other sources). The abstracts are cited when used as the only source.

Link to Chapter IV.2
Link to www.guidelines.gov

EPA used current Medicare reimbursement guidelines (1999) to obtain cost estimates for medical services. Supporting information came from the medical and economics literature. As a national system for medical services reimbursement, Medicare approximates the average cost of medical services in the United States. EPA therefore considered Medicare to be a reliable source for the cost estimates. For a more detailed discussion of the use of Medicare information, see Section B in Chapter IV.2, Medical Costs of Asthma.

Link to Chapter IV.2, Section B.

EPA determined medication costs using consumer prices for the common, over-the-counter (OTC) medications used to treat the symptoms. These costs are discussed in detail below.

V.2.B.2. Approaches Considered

There are at least two ways to approach the cost estimation of these symptom groups. The first is based on an assumption that a physician would not readily determine that the patient's symptoms were related to indoor air quality problems. Using this approach would involve estimating the likelihood that physicians would carry out numerous diagnostic tests, estimating the costs of each test and/or referral to a specialist, evaluating treatment options with their probability and cost, and summing these across all patients. This approach requires data on:

1) the specific services that may be provided,

2) the probability of any service being provided to the cross-section of patients within the symptom group, and

3) national average costs for the treatment or service.

Demographic characteristics would also be important because there are differences in treatment of children, adults, and elderly adults.

The second approach, and the one used in this analysis, is based on the much simpler assumption that the physician would diagnose the cause of the problem during the first visit, based on a careful review of the patient's history and symptoms. Additional cost data are provided to supplement the rapid diagnosis approach and can be used at the analyst's discretion.

This rapid diagnosis assumption has three advantages:

1) From a medical/scientific perspective, it is reasonable to assume that many physicians are aware of sick building syndrome or other potential effects of indoor air pollution. Sufficient information is provided in the medical literature to alert them to the problem.

2) This approach provides cost-conservative values and avoids overestimation of costs. The assumptions made using this approach are that symptoms result from relatively simple causes and that they will require relatively simple treatments. (These assumptions also pose a disadvantage, as noted below). It is extremely likely that the cost estimates provided in this report will NOT overestimate costs. This approach is more likely to underestimate costs because some physicians will do additional testing or refer the patient to a specialist.

3) This approach is a rapid and cost-effective response required for this analysis, and provides a quick and low-cost evaluation.

The major drawback of this approach is that it is likely to underestimate costs. It is not likely that all physicians will diagnose the symptoms listed above as a syndrome related to air quality problems on the first visit. In fact, there is considerable variation in how medicine is practiced and how aware physicians are of new types of diagnoses.

V.2.B.3 Additional Diagnostic Costs

To address the contingency that additional office visits may be made and that tests unrelated to the actual cause of the symptoms may be performed, additional information is provided for each symptom group regarding various medical actions that may be taken. These services and evaluations would not be included in a quick diagnosis of the source and resolution of the problem (i.e., removing the environmental cause of the symptom), but may be carried out for some patients. The analyst can use this information to construct a more complex and costly diagnostic scenario.

"Assumptions" regarding diagnosis and treatment are listed for each symptom group and area based on the simplest likely approach to diagnosis. To address additional diagnostic costs, they include a list of services that are *not* considered in this analysis (e.g., no referral to an

allergist). These elements can also be considered as additional costs, based on the application of these data.

A separate listing is provided of some other symptom causes that may be considered during diagnosis, tests that may be done, and referrals that could be made with costs for some of the more complex procedures. This supplementary information is provided under the heading "other costs," and may be used to estimate the costs of services, evaluations, and/or diagnostic tests that are not considered very likely to but which may be incurred. Use of these values can also provide a range of cost estimates.

Obtaining information on all potential screening tests for symptoms would necessitate consultation with a number of physicians (e.g., physician panels), which is beyond the scope of this work. The information provided here (as noted above) is based on a brief review of clinical practice guidelines, medical texts, and journal articles.

V.2.B.4 Symptom Treatment Description

To obtain a diagnosis and treatment description for each symptom group, clinical practice guidelines, medical abstracts, and clinical texts were reviewed. These sources all focus on linking symptoms to specific diseases or underlying causes (as discussed in Section V.2.A, above). When they proceeded to address the problem of poor indoor air quality, all the sources reiterated the most obvious medical approach to symptoms resulting from indoor air quality problems: *altering the air quality in the environment of the patient*. This change is accomplished through either moving the patient's indoor location, or by improving the air quality where that patient is exposed.[4] Most practice guidelines specify this approach as the *only* effective method of eliminating symptoms that result from poor indoor air quality.

Changing the worker's environment is legally enforceable for most jobs under the Americans With Disabilities Act (according to Occupational Medicine specialists). In practice this is not always a solution. Changing a home environment, while possible, may also be difficult.

When the assumption is being made that members of the exposed population cannot improve their air quality, the treatment of the symptoms becomes "symptomatic." This means that physicians will provide patients with recommendations about how they can minimize the discomfort associated with their symptoms. In some cases, the patients may not see a physician and may determine on their own that they should use symptomatic treatment. To address this option, costs are presented

[4] If the cause of the symptoms is through some other media (e.g., drinking water), then the environmental trigger would need to be removed as well.

below, in sufficient detail so that calculations can be made of total medical costs both with and without physician's office visits. For purposes of totaling the costs, it is assumed that persistent symptoms would result in an office visit.

The exposures resulting in these symptoms are unlike "dangerous" occupational exposures, which can lead to permanent major physical damage (e.g., liver or kidney disease, cancer, birth defects). The symptoms caused by air quality problems would not routinely be expected to result in medical problems requiring surgery, other in-hospital treatments, or ongoing in-office treatments. For most symptom groups, diagnosis is likely to consist of one visit and one or a few diagnostic tests. Treatment may consist of obtaining OTC medication, such as analgesics (e.g., aspirin, ibuprofen, acetaminophen), sore throat lozenges, body lotion, eye drops, etc.

Although standard practices are discussed in this chapter, there are substantial differences in how medicine is practiced. Even when diagnoses are identical, physicians differ in their acceptance of, and adherence to, clinical guidelines. The physician may also want to see the patient for follow-up periodically, or the patient may want further consultation after the initial visit. Individual cost elements, such as the cost of office visits, are described below so that different assumptions can be made regarding the number of office visits. Relatively simple assumptions are made to calculate total costs in this analysis, but it is very straightforward to alter these assumptions if necessary.

V.2.B.5. Cost Estimate Assumptions

Cost estimation usually relies on either:

1) obtaining cost data from the literature for a specific disease; or

2) describing a treatment profile, consisting of treatments and services that would commonly be followed for a particular disease, and obtaining probabilities of use and expenditure values for each treatment component.

This analysis follows the latter approach because recent publications did not contain information on the costs of treating the symptom groups.

The descriptions of diagnosis and treatment services contain many options. These options, discussed below, were selected to provide the most representative approach, based on the information reviewed. They were also selected to provide a reasonable low-cost estimate, assuming that the consumer would make wise choices when options are available (e.g., choose generic low-cost aspirin, rather than expensive name brand

options). Consequently, the assumptions that were made contribute to the overall cost-conservative approach taken in this analysis.

V.2.B.5.1 Office Visits

EPA used the Medicare reimbursement system was used as a source of cost information for medical treatments and tests. This system designates each reimbursable event with a Current Procedural Terminology CPT code, which is listed with the cost data below.[5] A basic diagnostic process is assumed, with history-taking and physical examination. Only those tests are included that are recommended in clinical practice guidelines (AHCPR, 1999; CDC, 1999) or commonly referred to in the medical literature. As indicated in the discussion above, it was assumed that a patient would have one diagnostic visit in a physician's office.

Costs for office visits differ based on their length. Visits are designated as levels 1 through 5, with 5 being the longest and most expensive. All office visits in this analysis were assumed to be at level 3, because it is the midpoint in both duration and cost. Office visit costs also differ, depending on whether the visit is for a new patient or an established patient (i.e., one who was seen previously by the same physician). It was assumed that half the patients had a personal physician and had been seen before by whomever they visited, and the other half were new patient visits. The costs are allocated between new and established patients with 50 percent in each group. A second visit during the same year was assumed to take place for 50 percent of patients; all patients were assumed to be established for the second visit. Using the above assumptions, the full cost for office visits is approximately $80.00 per year. This value, broken out into specific visits and the probability of receiving services, is shown in tables of each symptom's costs in later sections of this chapter.

Including this level of detail makes it possible to analyze different assumptions regarding the length and cost of the visit. In addition, Appendix V.2.B provides costs for the full spectrum of office visits (levels 1 through 5) for new and established patients.

Link to Appendix V.2.B

V.2.B.5.2 Medications

All medications considered in this analysis are common, OTC medications available at both drug and other types of stores (e.g., groceries, discount stores). EPA estimated medication costs using the lowest cost for a

[5]Additional information on the Medicare reimbursement system, and specific sources within the system that were used for costs of office visits and diagnostic tests, are listed in Section B of the Chapter IV.2 (asthma).

Link to IV.2.B

generic product, based on prices obtained from a relatively low-cost national pharmacy chain store on October 27, 1999. EPA preferred prices taken directly from consumer goods over those taken from an industry source (e.g., the Red Book) because these are OTC medications and their consumer prices were readily available directly from the marketplace.

The medications considered are very common (e.g., aspirin) and there a high demand for these products, market pressures have therefore made their prices fairly uniform. Most patients are not expected to pay substantially higher prices than those used in this analysis. When more than one medication could commonly be used for a particular purpose (e.g., analgesics), EPA calculated the average of the costs for the different types of medications. If one option was much more expensive than others, consumers were assumed to make an informed choice to use the less expensive option.

Medications were assumed to be taken daily. Most package regimens indicate they are taken more than once per day and were assumed to be taken throughout the day, not to exceed the recommended dose. When the medication is to be taken more than once per day (e.g., every 4 hours) the daily dose was calculated for only waking hours. It was assumed that symptoms will not be sufficiently bad that someone would get up at night to take the medication. Sore throat medication is assumed not to be taken at mealtime (which occurs 3 times per day), thus reducing the daily dose frequency. Medications were assumed to be taken at the average recommended dose levels for adults. Lacking an average level, it was assumed that the lowest recommended dose was taken. For example, if one to two tablets are recommended, it was assumed that one would be taken. Eye drops and nose drops can be applied to one or two eyes or nostrils. It was assumed that both eyes or both nostrils would be affected and require medication.

It is not known what percentage of patients with these types of symptoms actually use the recommended daily dose. Assuming a full set of doses per day may be appropriate for some people, but may overestimate or underestimate doses and costs for others. Some patients use more than the recommended dose. For the medications considered in this analysis, such practices would not usually result in overt symptoms associated with an overdose. Consequently, patients could continue to exceed the recommended dose. Some patients are likely not to use any medication for symptoms, due to personal beliefs, or interactions of the symptom medications with other medications or conditions. Costs for medical treatments without medication can be calculated from the other cost components listed in the tables that follow. Due to the popularity of "natural" medicines and the common nature of the symptoms, it is very likely that some people may treat their symptoms using this approach.

"Natural" medications are often more expensive than those evaluated in this analysis.

Appendix V.2.A contains information on the cost calculations for medications.

Link to Appendix V.2.A

V.2.B.6. Cost Estimates for Symptom Groups

This section contains information on the cost of medical services and products used to address the symptoms. These costs are summarized in a table for each symptom group. Diagnostic tests and medications are listed along with assumptions regarding the medical services. The assumptions listed with each symptom group table itemize treatment options that were NOT used in this analysis because they are considered unlikely, based on the literature reviewed. The sources of additional costs that may be incurred but are unlikely are listed under "other costs" at the end of each symptom group discussion. The dollar values of these services are listed in Appendix V.2.B for office visits and services, and in Appendix V.2.C for services related to allergy diagnosis and treatment.[6] This information can be used as the basis for additional evaluations if the cost of more complex diagnosis and treatment is desired. The basic cost information presented in the tables below can be modified using the data in the appendices, and through making different assumptions regarding the length of services and other parameters, depending on the nature of the cost analysis being carried out.

Link to Appendix V.2.B
Link to Appendix V.2.C

The costs of each good or service are listed in the table with their probability of use. The weighted cost is the unit cost times the probability of service. The cost estimates below are for a one-year period, and rely on specific assumptions about the number of office visits and medications taken (e.g., one office visit is assumed for all patients and 50 percent of patients, are assumed to have a follow up visit within a year).

In all cases, the referral to a specialist is possible and is not considered in this analysis. Lacking reliable information in the literature on these and other cost factors (e.g., testing), assumptions were made that are relatively cost-conservative. When using these numbers in specific analyses, the actual duration of the symptoms (if known) can be used to pro-rate the costs appropriately. Likewise, specific information on the severity of

[6] Note that office visit costs do not vary by the level or type of practitioner specialization. Consequently, a single cost for any single level of office visit is provided.

symptoms, physician practice patterns, and patient behavior can be used with the cost information below, to tailor an economic analysis to appropriately fit the exposure and response scenarios of interest.

The costs of treating allergies that may be responsible for symptoms are described in Appendix V.2.C. Whether or not these costs are added to symptom group costs when symptoms are likely to occur in response to allergens will depend on the specific pollutant eliciting the symptom. The proportion of patients electing to undergo allergy therapy will vary based on many factors. No estimate of the proportion of patients who undergo allergy treatment as a result of the symptoms discussed is made in this chapter.

Link to Appendix V.2.C

V.2.B.6.1 Dry, Itching or Irritated Eyes

Diagnostic tests: none

Medications: eye drops

Assumptions: a full evaluation for "dry eye" will not be done, referral to an opthamologist or allergist will not take place, and an allergic work up will not be done.

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
medication: eye drops	$ 17.76	100	$ 17.76
Total cost			**$ 97.27**

Other costs: additional office visits to an opthamologist or allergist. Office visit costs are listed in Appendix V.2.B, and the costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.B
Link to Appendix V.2.C

V.2.B.6.2. Headaches

Diagnostic tests: none

Medications: analgesics. The average of the costs for aspirin, acetaminophen, and ibuprofen was calculated.

Assumptions: CT scans, MRIs, and other sophisticated tests to evaluate anatomical or physiologically-based brain disorders will not be done and the patient will not be referred to a neurologist.[7]

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
medication: analgesics	$42.27	100	$42.27
Total cost			**$121.98**

Other costs: additional office visits to an neurologist or allergist. Office visit costs and costs associated with CT scans and MRIs are also listed in Appendix V.2.B, and the costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.B
Link to Appendix V.2.C

[7] One study of clinical practices found that approximately 3 percent of patients complaining of headaches were given CT scans. These were primarily patients who were thought to have tumors (Becker et al., 1993).

V.2.B.6.3. Sore or dry throat

Diagnostic tests: strep throat (for streptococcal pharyngitis)

Medications: throat lozenges

Assumptions: these patients would be screened for the most common cause of sore throat that requires medical treatment (strep throat), but would not be evaluated for gastric reflux, cardiac disorders, or other relatively uncommon causes of sore throat; referral to an ear, nose, and throat specialist will not occur.

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
Diagnostic tests: streptococcal throat culture	$13.05	100	$13.05
medication: throat lozenges	$201.76	100	$201.76
Total cost			**$294.32**

Other costs: additional office visits to an ear, nose, and throat specialist or allergist. Office visit costs are listed in Appendix V.2.B, and the costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.B
Link to Appendix V.2.C

V.2.B.6.4. Unusual tiredness, fatigue, or drowsiness

Diagnostic tests: complete blood count (CBC), thyroid screen

Medications: CDC specifies that there are no known treatments for chronic fatigue syndrome (the most analogous medical condition), although there is not complete medical consensus on this. Some physicians recommend nutritional changes. These changes are not anticipated to incur additional direct medical costs.

Assumptions: these patients would be screened for very common causes of fatigue, such as anemia and thyroid deficiencies, but they would not be intensively evaluated for apnea, sleep disorders, or other disease-related or structural causes of fatigue.

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
diagnostic tests: CBC, thyroid screen (T3, T4, TSH)	$62.40	100	$62.40
medication: none	not applicable	not applicable	not applicable
Total cost			**$141.91**

Other costs: additional office visits to an allergist. Office visit costs and the costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.C

V.2.B.6.5. Stuffy or runny nose (rhinitis) or sinus congestion

These symptoms are evaluated as rhinitis, defined as an imflammation of the mucous membranes in the nose (Dorland's, 1994). Diagnosis is subjective; a runny nose may not be considered rhinitis, and sinus congestion may not be considered sinusitis under all circumstances. If a runny nose or sinus congestion continue for a long time or recur many times, they are more likely to be considered rhinitis or sinusitis, leading to the medical tests listed below.

Diagnostic tests: nasal cytology. The Medicare reimbursement system does not list costs for nasal cytology, which is likely for rhinitis (based on the literature). It is recommended that the cost of throat culture be used, due to their similarity.

Medications: nose drops. Oral antihistamines and other medications could be used, but they act systemically, causing side effects. It was assumed that patients would select the medication with the most specific action and minimal side effects, so nose drops were chosen for the analysis.

Assumptions: these patients would be screened for common causes of rhinitis (via nasal cytology tests), but would not be extensively evaluated for sinusitis (e.g., via x-rays), or allergies. They would not be referred to an allergist.

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
Diagnostic tests: streptococcal throat culture	$13.05	100	$13.05
medication: nose drops	$42.66	100	$42.66
Total cost			**$137.22**

Other costs: additional office visits to an ear, nose, and throat specialist or to an allergist. Office visit costs and the costs of nasopharyngoscopy and rhinometry, and x-rays to examine the sinuses, are included in Appendix V.2.B. The costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.B
Link to Appendix V.2.C

Additional information on rhinitis (runny nose) was collected that may be relevant. Rhinitis is associated with sleep loss, secondary daytime fatigue, learning impairment, acute and chronic sinusitis, nasal polyps, otitis media with and without effusion, hearing impairment, abnormal cranofacial development in children, apnea, and asthma aggravations. There is also an increased likelihood of developing asthma. Sedating antihistamines used to treat rhinitis may cause dangerous situations due to sleepiness (Settipane, 1999).

A survey of 2,600 adults with seasonal and allergic rhinitis determined the following medication patterns: 18 percent used prescription drugs, 17 percent used prescription and OTC drugs, 46 percent used OTC only, and 18 percent used no medications. Severely-affected patients need environmental control and immunotherapy (Slavin, 1999).

V.2.B.6.6. Dry or itchy skin

Diagnostic tests: none

Medications: skin lotion

Assumptions: the patient would not be evaluated for allergies or for rare skin disorders.

Annual Estimated Direct Medical Costs for the Average Patient			
Cost Category (CPT code for medical services)	**Cost**	**Probability of Use (%)**	**Weighted Cost**
office visit: new patient, level 3 (CPT code: 99203)	$76.06	50	$38.03
office visit: established patient, level 3	$41.68	50	$20.84
second office visit: established patient, level 3	$41.68	50	$20.84
medication: dry skin lotion	$ 6.66	100	$ 6.66
Total cost			**$86.17**

Other costs: additional office visits to a dermatologist or an allergist. Office visit costs are listed in Appendix V.2.B, and the costs of allergy diagnosis and treatment are listed in Appendix V.2.C.

Link to Appendix V.2.B
Link to Appendix V.2.C

APPENDIX V.2.A. MEDICATION COST CALCULATIONS

This appendix presents the calculation of medication costs for each symptom group. EPA estimated annual doses using the recommended daily doses on each package, multiplied by 365. Assumptions regarding dose are discussed in Section V.2.B.5.2. The cost calculations are carried out by dividing the annual dose by the number of doses per package, yielding the number of packages per year. That number is multiplied by the cost per package to obtain the annual cost.

Analgesics:

ingredient	cost per pkg/ doses per pkg	daily dose	annual dose	annual cost
aspirin	6.49/500	6	2190	$28.43
acetaminophen	8.59/200	4	1460	$62.71
ibuprofen	12.22/500	4	1460	$35.68

The average was calculated based on an assumption that a third of patients would use each of the three options above; the average cost per year is $42.27. Consumer choice in this case is not based solely on price. The more expensive options have characteristics that may make them more advisable for some groups (e.g., children cannot take aspirin and some physicians won't prescribe ibuprofen to them, so acetaminophen may be the only option).

ingredient	cost per pkg/ doses per pkg	daily dose	annual dose	annual cost
Eye Drops:				
tetrahydrozoline	3.59/590	8	2920	$ 17.76
Throat Lozenges:				
dyclonine	1.99/18	5	1825	$201.76
hexylresourcinol	1.99/18	5	1825	$201.76
menthol	1.59/16	10	3650	$362.72

The cost of menthol lozenges was not used in the analysis because it was assumed that consumers would choose the less expensive therapy, and because menthol drops are taken hourly, which would also be a disincentive to using this product.

	ingredient	cost per pkg/ doses per pkg	daily dose	annual dose	annual cost
Nose drops:					
	phenylephrine	4.27/590	16	5840	$ 42.66
Dry skin lotion:					
	numerous	2.19/120	1	365	$ 6.66

The use of dry skin lotion was very difficult to assess because people may apply it to some or all of their body. This could easily generate an order of magnitude difference in dose and cost estimates. There is no standard "dose." For purposes of this analysis, it was assumed that the areas of skin normally not covered with clothes among indoor workers (hands and face) would be treated. It was also assumed that no expensive prescription medications were used. It was not possible to precisely determine the quantity of lotion used; EPA estimated that people would use 1/8 ounce per day, and would use it once per day. This assumption may underestimate costs for some people.

APPENDIX V.2.B. SUPPLEMENTAL COST INFORMATION

This appendix provides cost information for services that are designated in the "other" category for each symptom group. These services are unlikely to be carried out, but may be used by some practitioners. In addition, hospitalization costs are provided for some symptoms (this is discussed in more detail below).

Services:

The costs of diagnostic tests and all levels of office visits are listed in Table V.2.B-1 below, with their Medicare code (HCPCS), costs, and potential relevance to symptom groups. Many of the tests are relevant to multiple symptom groups. As the table shows, each type of test has many variations. The MRI and CT scans costs represent the total or "global" reimbursement, including both professional and technical services related to performing and interpreting the test. Two new medical tests for rhinitis are included in Table V.2.B-1, based on a review of the literature. These two tests, listed under "special otorhinolaryngologic services," are used to diagnose and determine both the severity of disease and the cause.

Hospitalization:

Although expected to be rare, hospitalization may occur for some symptoms, when they are diagnosed as serious forms of some diseases: rhinitis and sinusitis. The costs for other potential diseases related to the symptoms groups are not listed; no diseases were identified that require hospitalization and are likely to occur as a result of poor indoor air quality in a non-industrial setting. Although indoor air contaminants are not expected to result in hospitalization, these data can be used to estimate an upper bound on costs that may be incurred under unusual circumstances.

The Medicare costs associated with hospitalizations for sinusitis and rhinitis are listed with the costs of otitis media and URI (upper respiratory system infection) in the Medicare system (the ICD-9 code for these diseases is linked to the DRG in the Medicare system). Hospitalization costs are listed for urban and rural areas in Table V.2.B-2 below (there is no single average value).

Table V.2.B-1: Cost of Services				
HCPCS	**Description**	**Source**	**1999 Medicare**	**Relevance to Symptoms**
Diagnostic Radiology				
70210	X-ray exam, sinuses, less than three views	1	$32.30	headache, sinus
70220	X-ray exam, sinuses, complete, minimum of three views	1	$42.72	headache, sinus
70450	CT scan, head or brain, without contrast material	1	$221.93	headache, sinus
70460	CT scan, head or brain, with contrast material	1	$270.91	headache, sinus
70470	CT scan, head or brain, without and with contrast material	1	$331.34	headache, sinus
70486	CT scan, maxillofacial area, without contrast material	1	$236.17	headache, sinus
70487	CT scan, maxillofacial area, with contrast material	1	$279.59	headache, sinus
70488	CT scan, maxillofacial area, without and with contrast material	1	$339.33	headache, sinus
70551	MRI, brain, without contrast material	1	$497.36	headache, sinus
70552	MRI, brain, with contrast material	1	$597.03	headache, sinus
70553	MRI, brain, without and with contrast material	1	$1,057.57	headache, sinus
Special Otorhinolaryngologic Services				
92511	Nasopharyngoscopy with endoscope (separate procedure)	1	$63.56	nose
92512	Nasal function studies (e.g., rhinomanometry)	1	$41.33	nose
Office Visits				
99201	Office/outpatient visit, new patient, level 1	1	$34.73	all
99202	Office/outpatient visit, new patient, level 2	1	$54.53	all
99203	Office/outpatient visit, new patient, level 3	1	$76.06	all
99204	Office/outpatient visit, new patient, level 4	1	$111.14	all
99205	Office/outpatient visit, new patient, level 5	1	$138.93	all
99211	Office/outpatient visit, established patient, level 1	1	$16.32	all
99212	Office/outpatient visit, established patient, level 2	1	$30.22	all
99213	Office/outpatient visit, established patient, level 3	1	$41.68	all
99214	Office/outpatient visit, established patient, level 4	1	$63.56	all
99215	Office/outpatient visit, established patient, level 5	1	$97.94	all

* Source 1: Medicare Physician Fee Schedule
Source 2: Medicare Clinical Laboratory Fee Schedule
** "all" refers to all symptom groups

Table V.2.B-2: Cost of Inpatient Hospital Care for Sinusitis/Rhinitis					
DRG	**DRG Description**	**ICD-9 Diagnosis Codes**	**DRG Relative Weight**	**DRG Payment for Operating and Capital for Large Urban Areas**	**DRG Payment for Operating and Capital for Other Areas**
68	Otitis Media & URI Age > 17 With Complications*	477.0, 477.8, 477.9	0.6699	$2,997.72	$2,834.27
69	Otitis Media & URI Age > 17 Without Complications	477.0, 477.8, 477.9	0.5053	$2,261.16	$2,137.86
70	Otitis Media & URI Age 0-17	477.0, 477.8, 477.9	0.3841	$1,718.80	$1,625.08
* URI refers to upper respiratory infection					

APPENDIX V.2.C. COSTS OF ALLERGY DIAGNOSIS AND TREATMENT

A brief analysis of the likely costs of diagnosing and treating allergies for five years is provided in this appendix. Of the various diagnostic investigations that may take place beyond primary care office visits (described above), allergy screening is most likely because many of the symptoms, as chronic events, would be suspected of arising from allergies. In addition, some symptoms may actually be due to allergic responses (e.g., to molds and mildews). Most symptom groups could be associated with allergies under some conditions. For example, rhinitis is often associated with headache and tiredness when it is due to allergies. In this case, the presenting symptom may be headache or tiredness if the runny nose is mild, while the underlying cause remains an allergic response. The distinction among the clusters of symptoms is to some degree anatomical, rather than functional.

This appendix provides cost data on allergy diagnosis and therapy because allergies may be suspected of causing many of the symptom groups considered in this chapter. Patients who have one or more symptoms that indicate allergy may undergo allergy screening. The patients may or may not ultimately be diagnosed as having allergies. Consequently, costs are provided for both diagnosis and treatment. Patients found to have allergies may not have "treatable" allergies. Only those patients found to be allergic to substances for which desensitization is possible will incur the treatment costs. Whether or not a patient can be treated depends on the nature of the allergy (i.e., the type of immune response elicited). Consequently, a small subset of patients with indoor air-induced symptoms may actually be treated for allergies.

Although numerous types of allergies are mediated by different components of the immune system, this section examines the most common type, IgE-mediated. Other types may result in higher diagnostic expenses and may not necessarily be treatable.

Allergy diagnosis usually involves exposing the patient to trace amounts of suspected allergens through various types of skin tests. This section provides a summary of costs for one approach: using numerous individual allergenic screens via skin testing. Sources reviewed for this work indicated that allergen tests relying on grouped allergens were less reliable and often produced results that are difficult to interpret. It was assumed that percutaneous skin tests would be done, rather than sequential tests, intradermal tests, etc. Table V.2.C-1 lists many of the allergy-related diagnostic tests and treatments that are carried out, along with their Medicare costs.

Table V.2.C-1: Cost of Allergy Services			
HCPCS	**Description**	**Source**	**1999 Medicare Payment**
Immunology			
86003	Allergen specific IgE, quantitative or semiquantitative, each allergen	2	$7.22
86005	Allergen specific IgE, qualitative, multiallergen screen (dipstick, paddle, or disk)	2	$11.02
Allergy Testing			
95004	Percutaneous (scratch, puncture, prick) tests with allergenic extracts, immediate type reaction	1	$3.82
95010	Percutaneous (scratch, puncture, prick) tests, sequential and incremental, with drugs, biologicals or venoms, immediate type reaction	1	$11.46
95015	Intracutaneous (intradermal) tests, sequential and incremental, with drugs, biologicals or venoms, immediate type reaction	1	$12.16
95024	Intracutaneous (intradermal) tests with allergenic extracts, immediate type reaction	1	$5.56
95027	Skin end point titration	1	$5.56
95028	Intracutaneous (intradermal) tests with allergenic extracts, delayed type reaction, including reading	1	$8.68
95044	Patch or application test(s)	1	$7.64
95060	Ophthalmic mucous membrane tests	1	$13.20
95065	Direct nasal mucous membrane test	1	$7.64
Allergen Immunotherapy			
95115	Professional services for allergen immunotherapy not including provision of allergenic extracts; single injection	1	$14.59
95117	Professional services for allergen immunotherapy not including provision of allergenic extracts; two or more injections	1	$18.76
95165	Professional services for the supervision and provision of antigens got allergen immunotherapy; single or multiple antigens	1	$7.29
99205	Office/outpatient visit, new patient, level 5	1	$138.93

* Source 1: Medicare Physician Fee Schedule
Source 2: Medicare Clinical Laboratory Fee Schedule

** "all" refers to all symptom groups

Percutaneous administration, the approach selected for cost evaluation, is the least expensive and generates the most cost-conservative estimate. The other tests are used less frequently, and are used primarily when percutaneous tests do not provide clear results. It was not known how often these or other tests listed (e.g., ophthalmic mucous membrane tests, direct nasal mucous membrane test) are used. Based on a rapid review of

the past two years of medical journals on allergy, they do not appear frequently. Cost data for these less common tests can be used to generate estimates using other assumptions regarding diagnosis and treatment.

In this analysis, the number of office visits, types of diagnostic screening, and treatment methods are estimated based on a review of national guidelines (CPG, 1995, and 1996). These guidelines are not very specific with regard to testing and treatment, because the course of action depends on the patient. EPA assumed that testing would be carried out for 50 allergens. More than 200 indoor air pollutants can be tested as allergens; a review of the literature indicated that 50 allergens would be a reasonable number. In the absence of specific statements regarding the "average" amount of testing, EPA used 50 as an estimate. Due to the number of tests performed, and the fact that the results are obtained through observation during the office visit, EPA assumed that a level 5 office visit would be required. It was assumed that the patient's first visit to the allergist is designated as a "new patient visit."

If an allergic response is diagnosed as the cause of the symptoms, the patients may choose to:

1) take over-the-counter (OTC) medications (or prescriptions) for the relief of symptoms and avoid allergy treatment,

2) remove the allergens from their environment or themselves from the environment and avoid allergy treatment, or

3) undertake therapy for desensitization to the allergen.

Symptomatic relief costs are shown for each symptom group in the body of the chapter above. The costs associated with option 2 are not direct medical costs. Option 3 costs are described here.

Immunotherapy treatment was assumed to be conducted over a five-year period. This duration appeared several times in the literature, although no clear statements were found regarding "average" treatment duration. After five years of treatment, many patients (although not all) can cease treatment and will probably be symptom-free. Allergy shots (immunotherapy) are administered on a regular basis. It was assumed in this analysis that they were administered weekly.

Medicare lists specific reimbursement for allergen immunotherapy, rather than using office visit costs plus specific services costs. The Medicare cost is listed in Table V.2.C-2 below. This cost analysis used the least expensive option. If the costs were assigned to an office visit, as may be the case for some private insurers, one could assume that administration of the immunotherapy injection would require little time in the office and a

level 1 office visit.[8] The costs of levels 1 through 5 office visits are listed in Table V.2.B-1 ($16.32 through $97.94) so that this cost can be estimated, if so desired.

The costs of allergy treatment and diagnosis, based on the assumptions stated above, are summarized in Table V.2.C-2, with a total cost estimate of approximately $4,500 for a five-year period. The majority of costs for allergic patients occurs during the long-term treatment to desensitize them to the allergens. This cost can be added to the costs described for those symptom groups where some percentage of patients are to be assumed to undergo allergy diagnosis and/or treatment. OTC medications were included in the symptom treatment cost estimate above, however, so are not included in Table V.2.C-2. Patients are unlikely to take both immunology and OTC medications.

Patients who are tested but determined not to have allergies (or who have allergies that cannot be treated) will incur only the costs of diagnosis. Based on the costs presented in Table V.2.C-2, these costs would total $690.93.

[8] Given the difficulty and expense of desensitizing someone with allergies, it seems quite unlikely that the patient would take no steps to remove the allergen during the five-year period.

Table V.2.C-2. Costs of Allergy Diagnosis and Treatment for Five Years (undiscounted, 1999$)

Procedure	Medicare HSPCS Code	Cost Calculation and Result
Allergy testing for 50 allergens — materials	86003	$7.22 per allergen × 50 allergens = $361.00
Allergy testing for 50 allergens — services	95115	$3.82 per allergen × 50 allergens = $191.00
Office visit level 5 — new patient	99205	$138.93
Immunotherapy for allergen	95115	$14.59 for a single allergen × 5 years of treatment × 52 visits per year = $3,793.40
Total cost		$4,484.33
Average annual cost for five-year period from diagnosis to completion of treatment*		$ 896.87

* The costs in the first year are higher due to diagnosis. This value is the average cost over the average period of treatment of 5 years.